Recycling of Dredged Material From Confined Disposal Facilities – Suitability and Sustainability Issues

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Focus

- Sustainability
  - Concept
  - Sustainability and confined disposal facilities (CDFs)
  - Management for sustainability
  - Strategy* and supporting research
- Suitability of dredged material for re-use
  - Criteria*
  - Characterization*
- Practice

Sustainable CDFs

- ***"…to manage dredged material disposal in such a manner that:***
  - ***1) disposal capacity is optimized and dredging operations are not limited by disposal capacity;***
  - ***2) operations are economically feasible now as well as in the future; and***
  - ***3) adverse environmental impact is minimized and benefits maximized."***

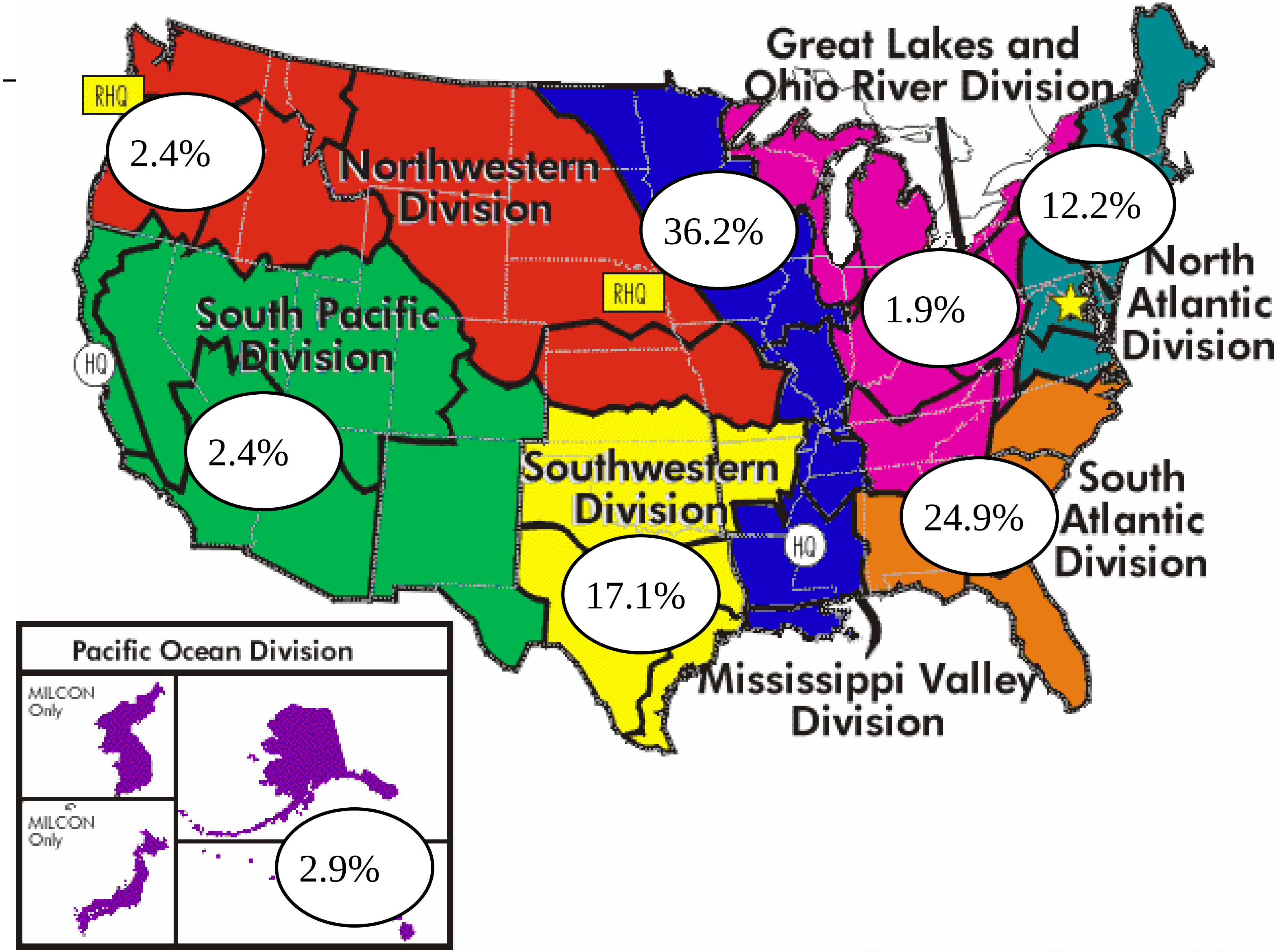
What is the significance of this issue?

- 33CFR 336.1, “The maintenance of a reliable Federal navigation system is essential to the economic well-being and national defense of the country.”
- Maintenance = Dredging
- Dredging = Disposal
- CDFs – costly, diminishing capacity
- Open water – not acceptable to all stakeholders
- BU - technical, environmental, and economic constraints

CDF Capacity – How big is the issue?

- District survey
  - Scope and importance of capacity issues
  - Customary disposal practices
  - Issues with policy, beneficial use, funding
- IWR database
  - Dredging volumes, methods
  - Disposal trends
- Online DMMPs, reports
- Inventory of CDFs

Dredging Volumes – 5 yr Average

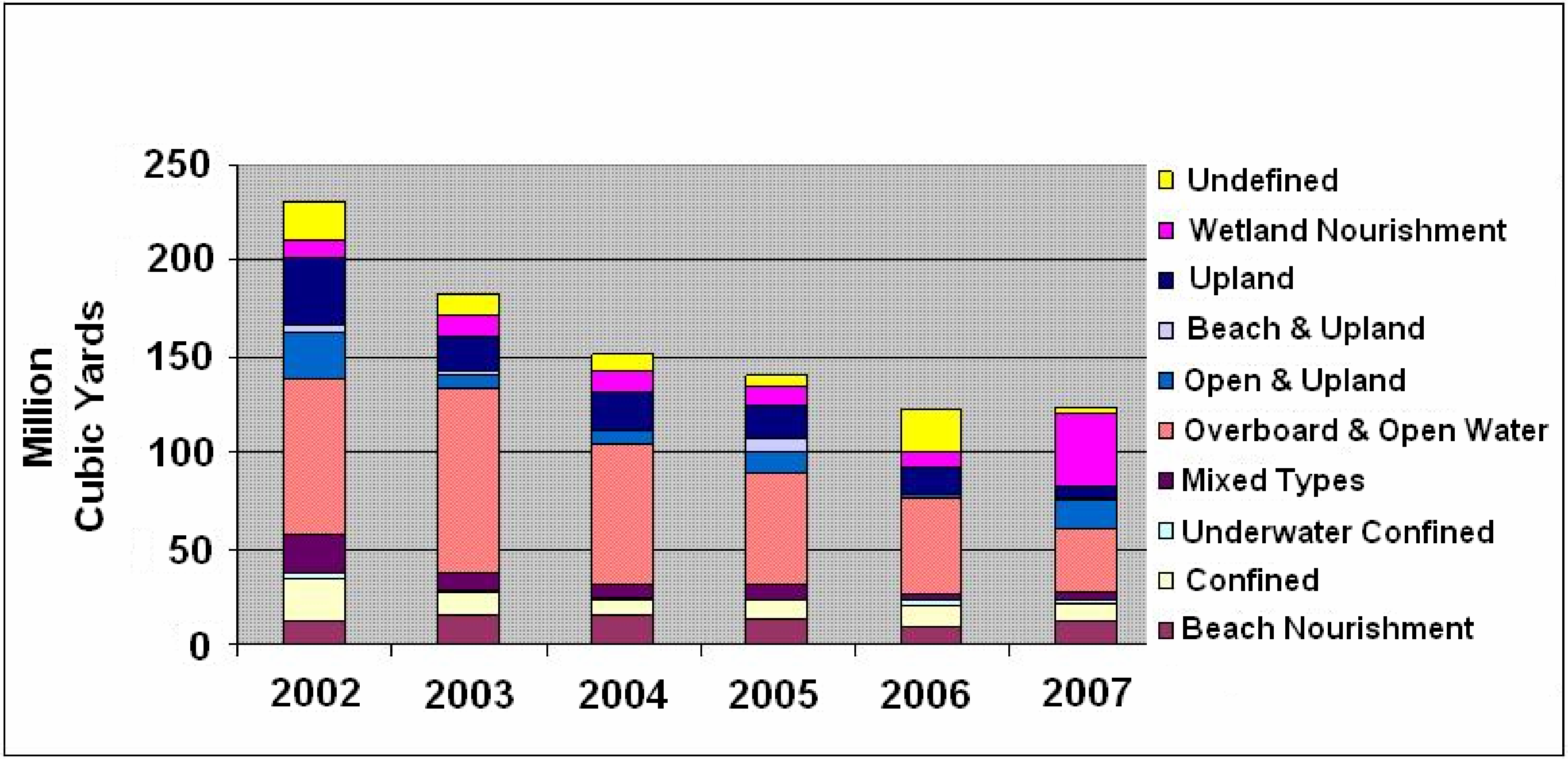


Reported capacity problems

- LRD (1.9%)[a]
  - Detroit District
    - Milwaukee (mean 360K cy/dredging cycle)
    - Green Bay (mean 360K cy/dredging cycle)
    - Duluth-Superior Harbor
  - Buffalo District
    - Cleveland (mean 290K CY/dredging cycle)
    - Lorain Harbor
- SAD (24.9%)
  - Charleston District
    - Areas along Atlantic Intracoastal Waterway (AIWW)
    - Middle Winyah Bay (Georgetown Harbor)
- MVD (36.2%)
  - MVN District
    - Calcasieu River
- NWD (2.4%)
  - Portland District
- SPD (2.4%)
  - San Francisco
    - 2 coastal projects with dangerous entrance channels
  - Sacramento
- SWD (17.1%)
  - Galveston District

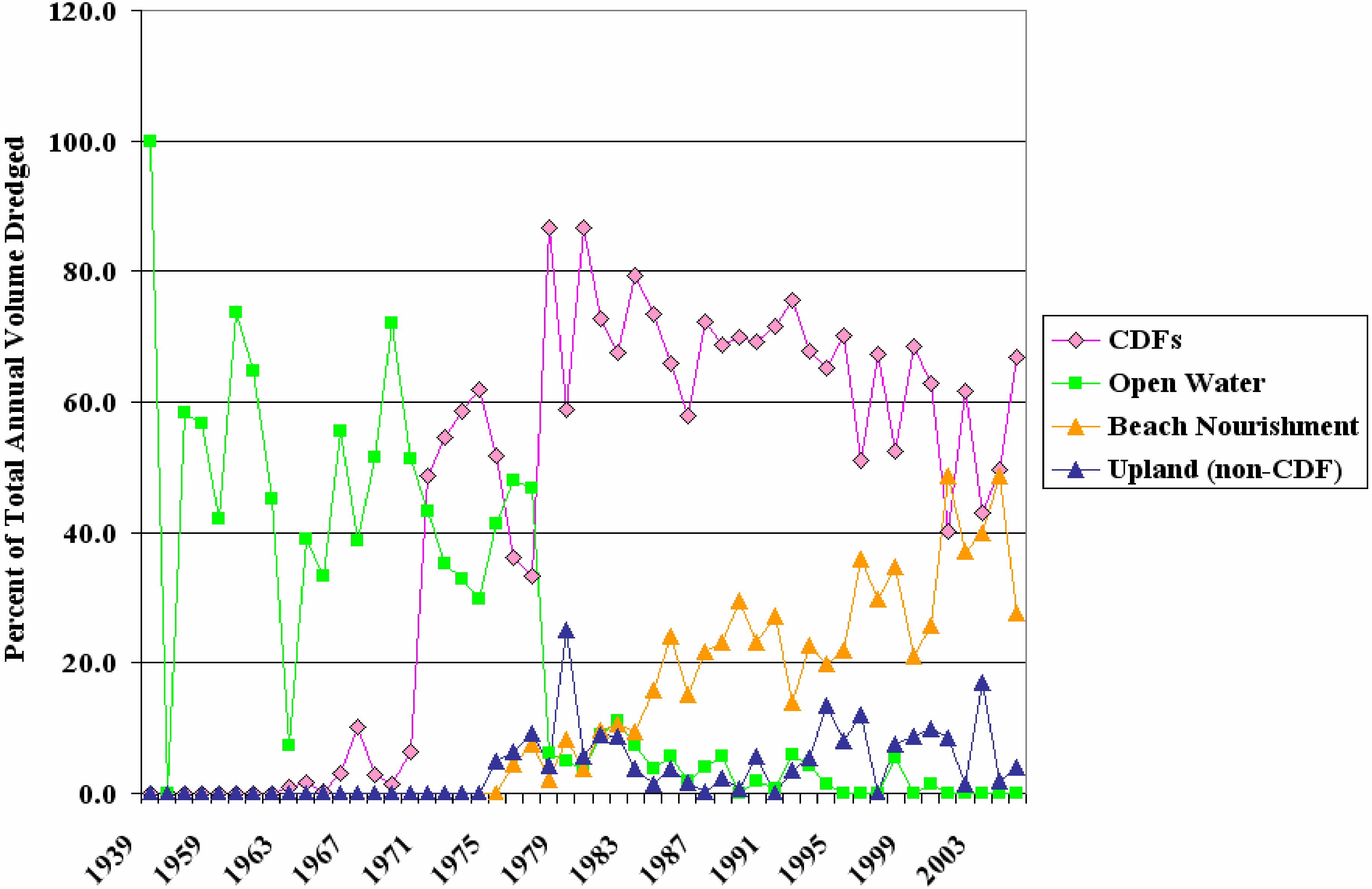
(a) Percentage of 5 yr average national dredging volume

Dredging & Disposal Trends

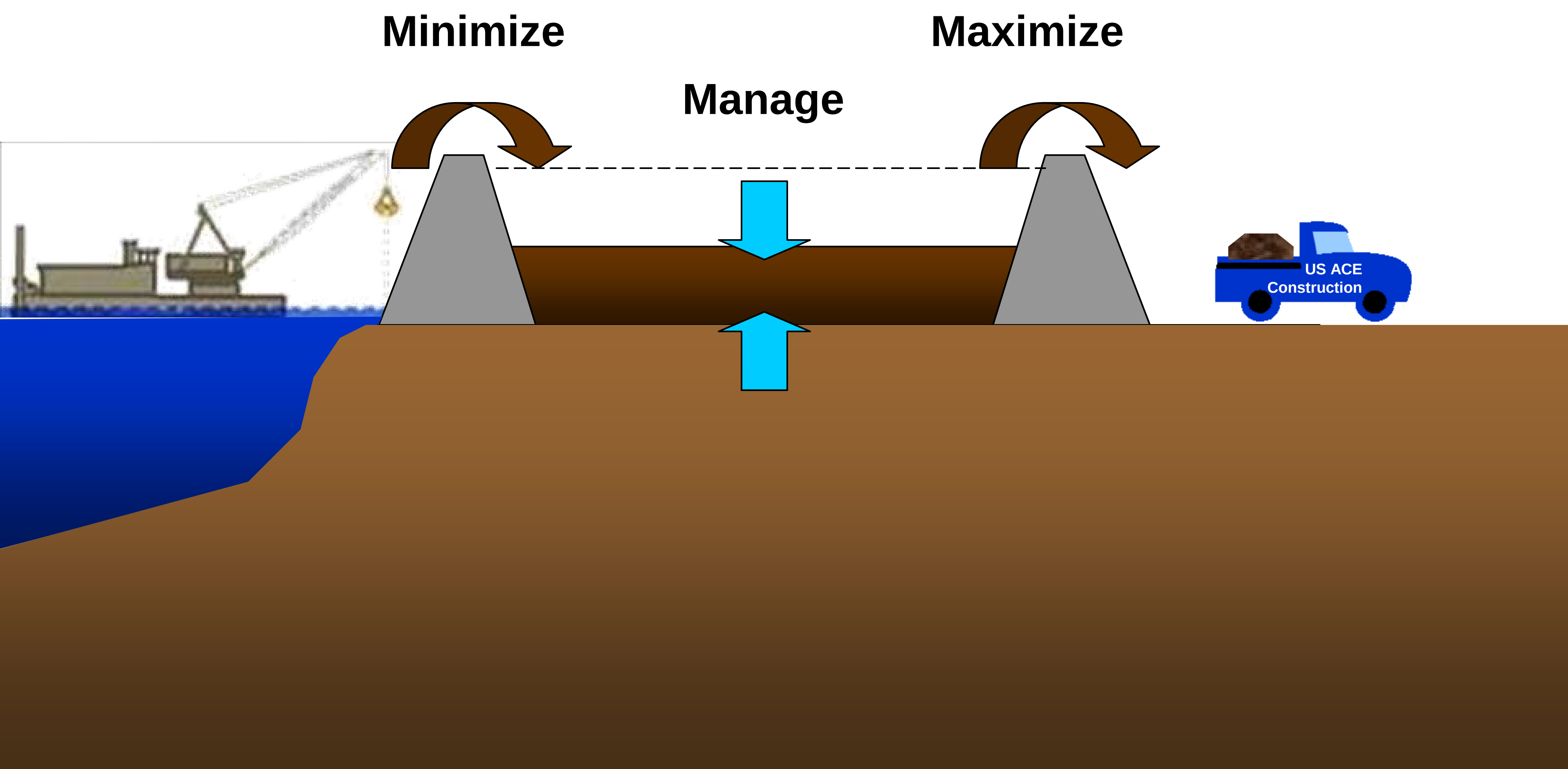


Corps of Engineers annual dredged material placement (IWR 2008)

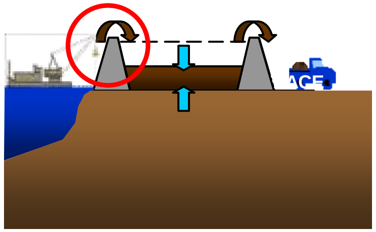
Disposal Method as Percent of Annual Dredging Volume for Detroit District



Sustainable CDFs – The Three M's

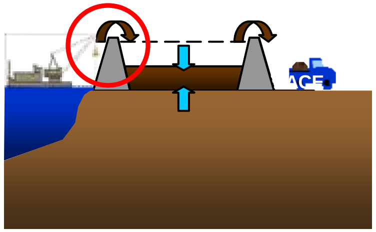


Minimizing Input to CDF



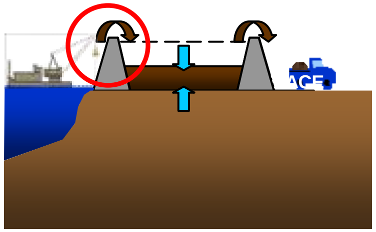
- Reduce dredging
  - Reduce sediment input to channel
  - Reduce shoaling
  - Eliminate un-necessary dredging
- Optimize dredging?
- Alternative or multiple placements

Erosion control



- Surface and bank erosion
  - Agricultural practices
  - Construction activity
  - Imperviousness of the built environment
- Programs
  - Voluntary regulation - farmland set-asides (USDA-NRCS)
  - Great Lakes Basin Program for Soil Erosion and Sediment Control (GLC/NRCS)
  - State water quality regulations
- Issues
  - Loss not controlled by the Corps
  - Once in the channel, Corps has responsibility
  - Multi-agency (state and federal authorities) efforts needed to strive toward sedimentation reduction.

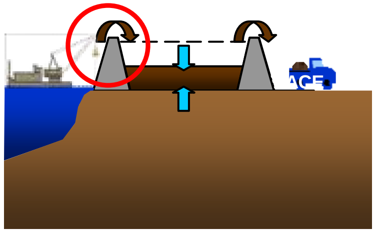
Shoaling prevention



- Concepts
  - Keep sediment moving
  - Keep sediment from entering an area
- Structures
  - Flow training
  - Flow augmentation
  - Barriers
  - Sedimentation basins
- Issues
  - Uncertain effects?

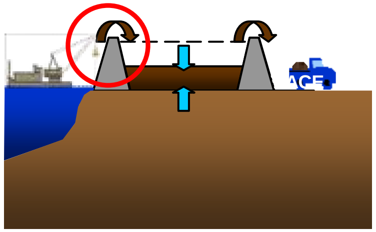
Engineer/artist's original concept

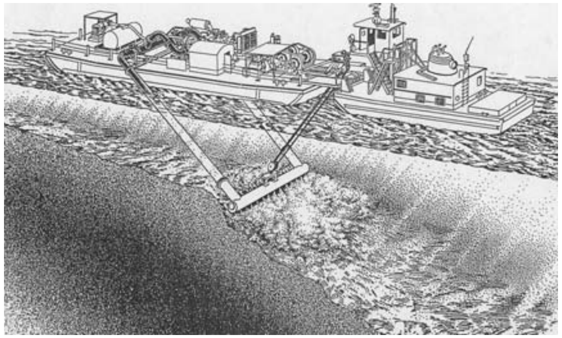
Un-necessary dredging



- Economic justification
  - Cost benefit ratio found for only one project
  - Interpreting annual tonnages and revenues in terms of justification for a dredging project would be even more difficult.
  - Evaluate true cost of deepening & widening
- Defining bottom
  - Measurement inconsistencies
  - Fluid mud

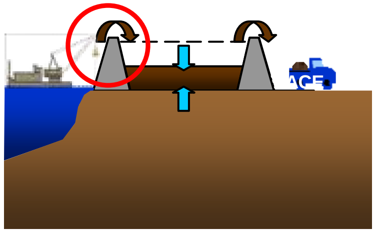
Optimizing dredging





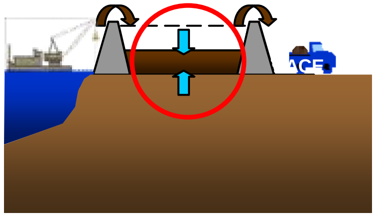
- Equipment
  - Water injection dredge
- Overdepth reduction
  - Initial disposal volume reduction
  - Advanced dredging = reduced long term volume?
  - More precision = more cost
  - Silent inspector
- Performance Specifications
  - Motivating optimum operation vs. constraining overdepth

Alternative placement



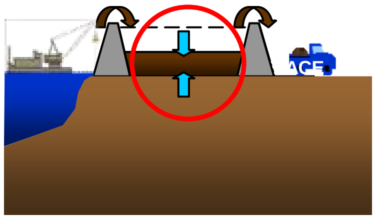
- Employ multiple disposal alternatives (for the same project)
  - Nearshore placement
  - Open water
  - CDF only when best or only option
- Issues
  - Cost and the Federal Standard
  - Life cycle economic analysis (value engineering)

Managing Capacity



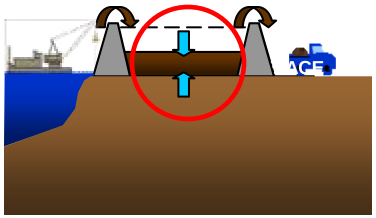
- Promote consolidation
- Judicious use of expansion
- Design or retrofit for material recovery

Promoting Dewatering & Consolidation



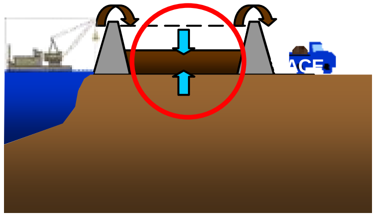
- Objective
  - Accelerate consolidation to free capacity
- Factors
  - Hydraulic or mechanical dredging
  - Compressibility of the material
  - Lift thickness, surcharge, drainage layers
- Dewatering tools
  - Wick drains, underdrains, trenching, thin layer placement
  - Geobags, phytodewatering, vacuum dewatering and electro-osmosis

Expansion



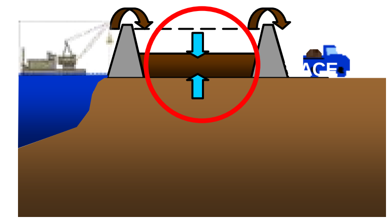
- Buying time – not a sustainable solution
- Utilize in place materials when possible
- Limitations
  - Foundation strength
  - Ability of in-place material to support construction equipment and dike footprint
  - Suitability of in-place material for dike construction
  - Dike raising and diminishing return at small sites
  - Wetland protection

Design & Retrofit for Material Recovery



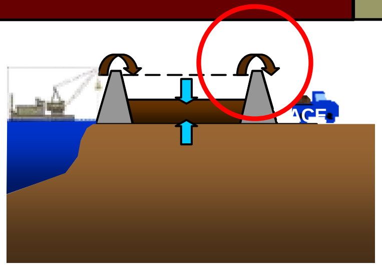
- Objectives
  - Segregation of clean vs. contaminated & coarse vs. fine materials
  - Simultaneous disposal and dewatering
  - Provide "treatment" and processing areas
  - Provide storage
- Compartmentalize
  - Exploit passive separation
  - Rotational disposal
- Issues
  - Limited technical/design guidance for non-traditional processes

In practice…



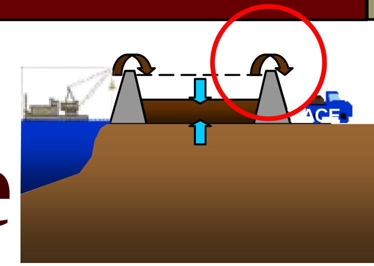
- Degree of CDF management varies by District
- 16 of 24 Districts reported active dewatering, including weir construction and management, and trenching
- Many Districts using dredged material for berm construction
- Physical separation was listed by five Districts
- Nine Districts reported actively employing material recovery

Maximizing Beneficial Use



- Greatest potential for benefit in terms of CDF life
- Limitations
  - Market
  - Perception
  - Policy
  - Scheduling
  - Funding
  - Criteria

Limitations on beneficial use



- Extensive preplanning requirements
  - Acquire real estate and obtain environmental clearances
  - Separate funding and authorizations
  - Incompatible with O&M dredging schedules
- Authorities
  - Inconsistent interpretation
  - Focus on aquatic ecosystem restoration/creation (WRDA)
- Lacking
  - Standard procedures
  - Global BU criteria
  - CDF characterization guidance

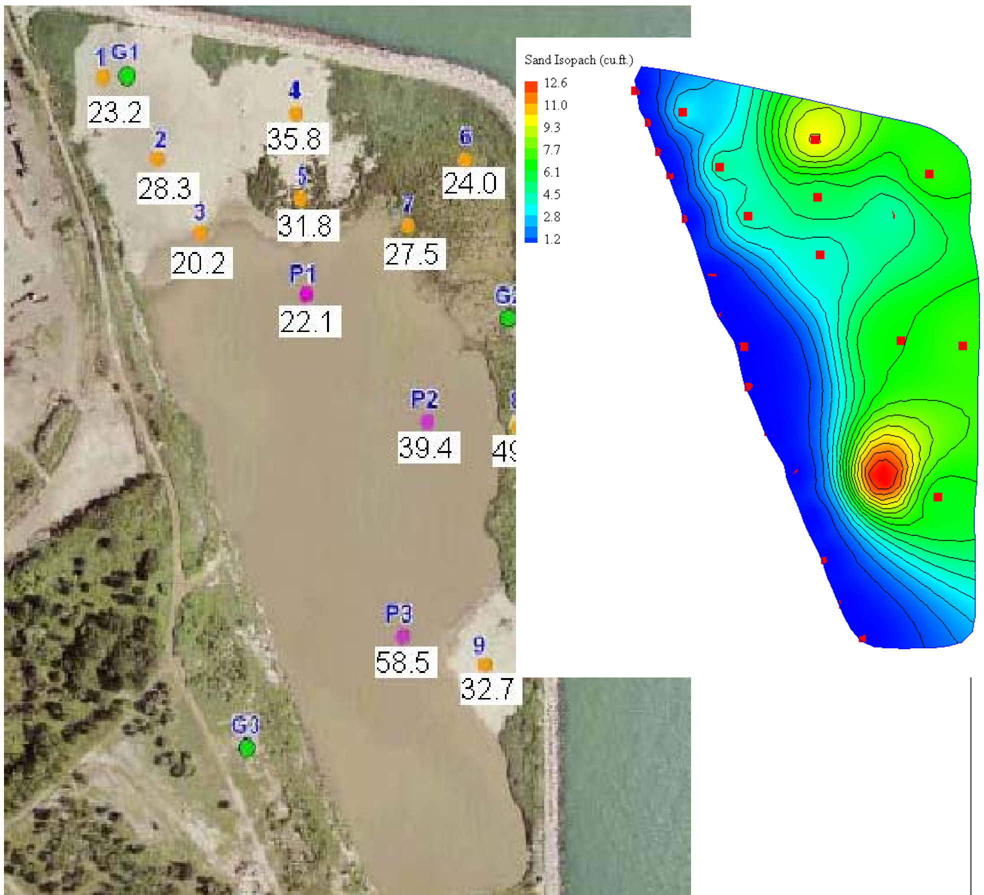
Recommendations from the field

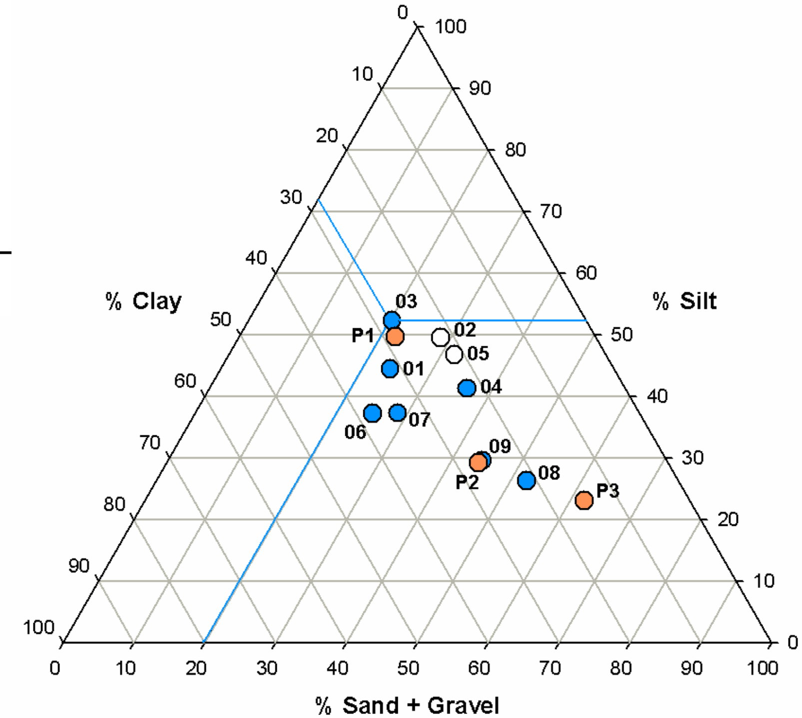
- Establish a national Dredged Material Management Team (DMMT)
  - Disseminate advances in beneficial use, criteria and market development
  - Work toward consistent policy interpretation or revision
- Establish business practices specific to BU
  - Standard Operating Procedure (SOP)
  - Program Management Plan (PgMP)
  - Project Management Business Practice (PMBP)

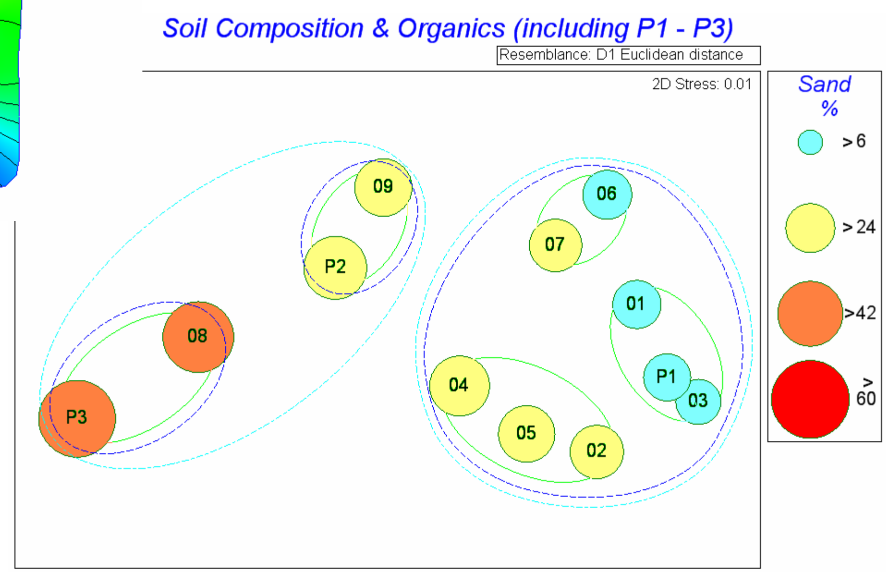
Supporting research

- Beneficial use criteria
  - Identifying data gaps
  - Developing criteria development approach
  - Engaging agencies for collaboration and buy-in
- CDF and material characterization
  - Maximizing information/minimizing sampling
  - Estimating and characterizing targeted fractions
  - CDF case study

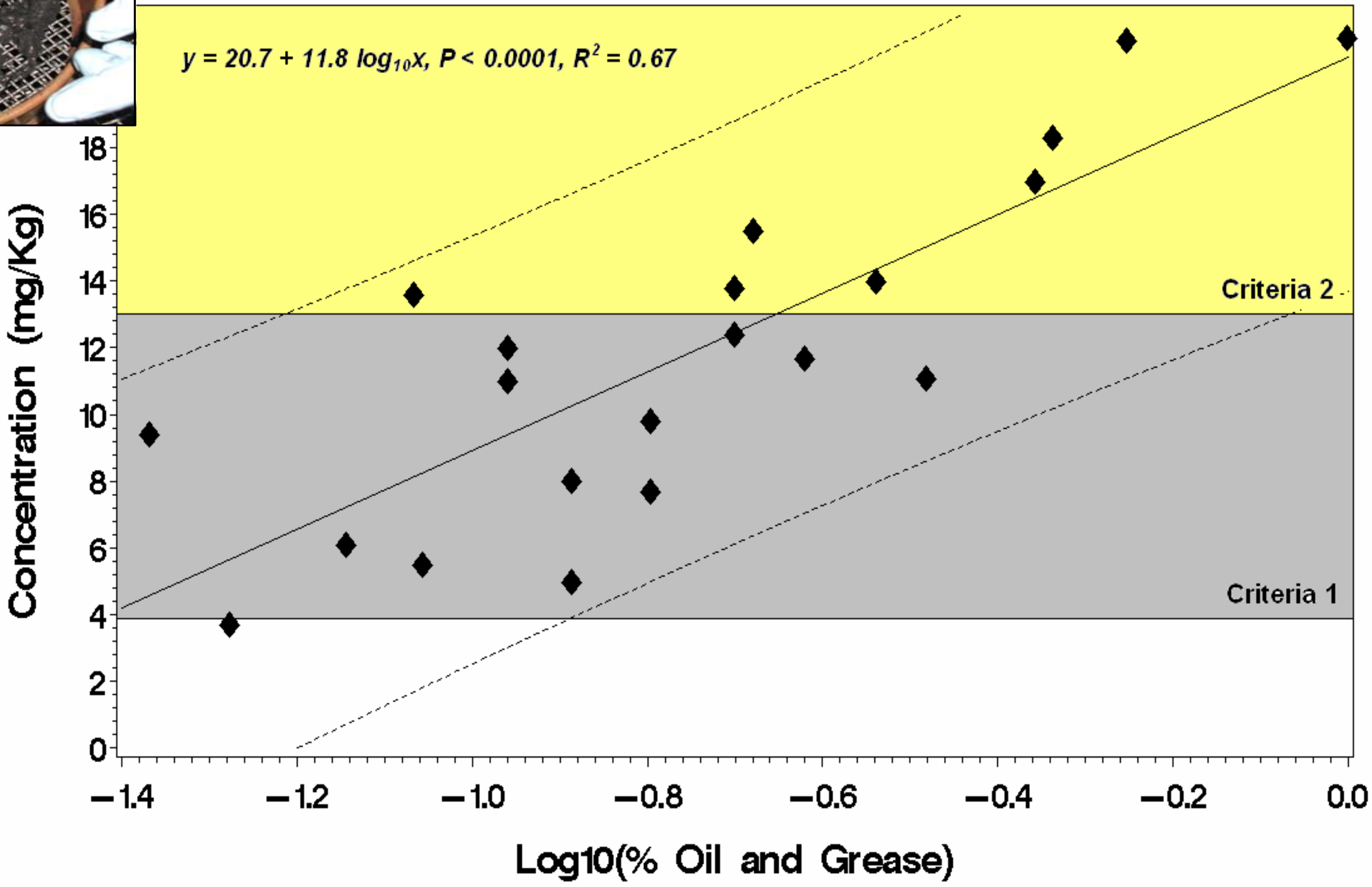
CDF case study

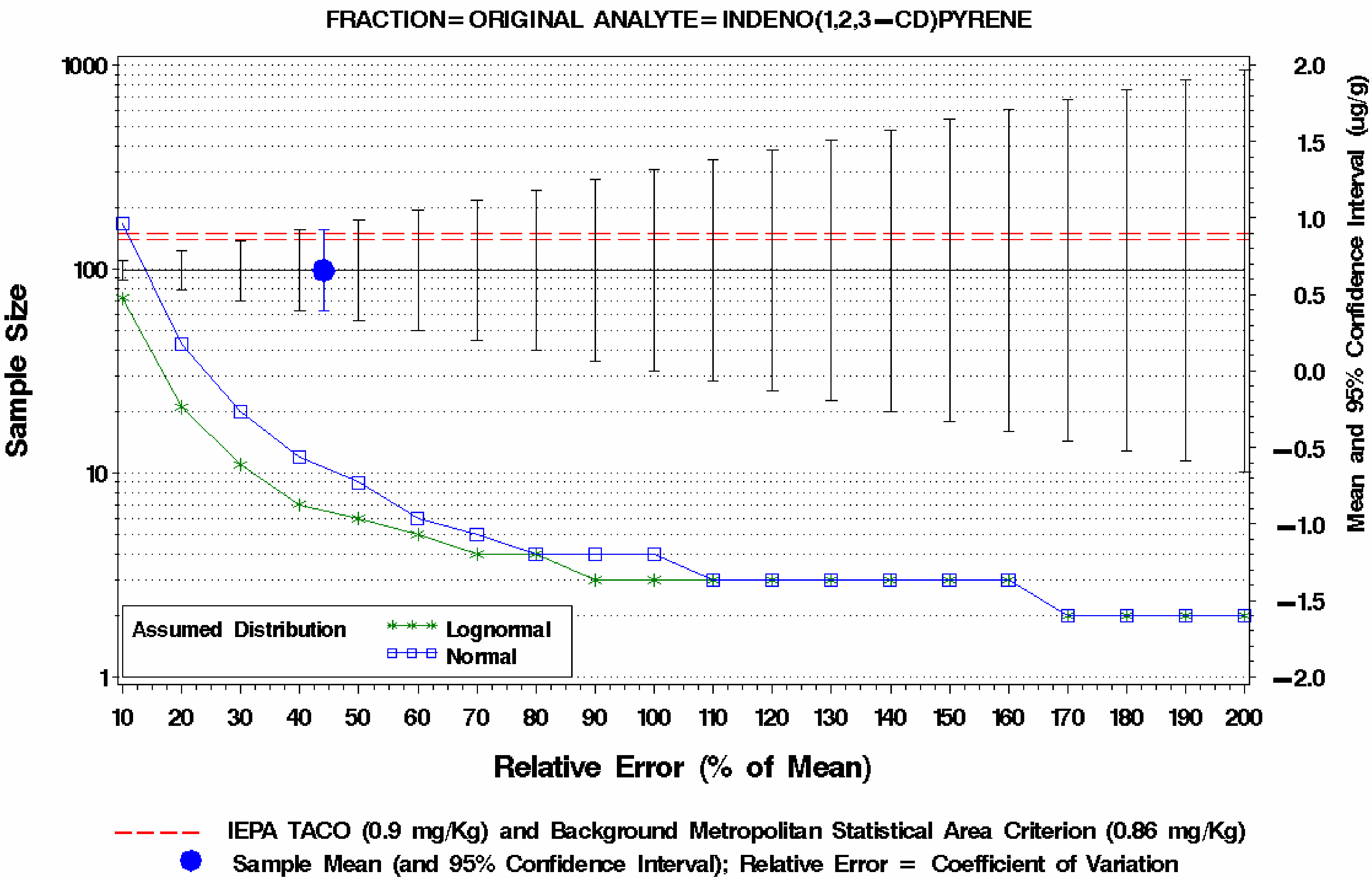






CDF case study



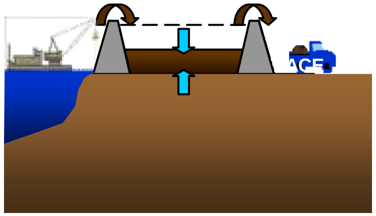


FRACTION=ORIGINAL ANALYTE=INDENO(1,2,3−CD)PYRENE
Sample Size
1000
100
10
1
Mean and 95% Confidence Interval (ug/g)
2.0
1.5
1.0
0.5
0.0
−0.5
−1.0
−1.5
−2.0
Assumed Distribution
Lognormal
Normal
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180 190 200
Relative Error (% of Mean)
IEPA TACO (0.9 mg/Kg) and Background Metropolitan Statistical Area Criterion (0.86 mg/Kg)
Sample Mean (and 95% Confidence Interval); Relative Error = Coefficient of Variation

Conclusions

- No silver bullet
- Existing tools and resources applicable to sustainable practices
- Policy, statutory and regulatory vehicles and impediments
- Research necessary to advance the practice of sustainable CDF management
- Need to integrate planning process with operations

Triage



- During DMMP development & periodic updates
  - Long-term cost analysis to collectively weigh minimization and dredging techniques and placement options.
  - Consider most modern tools available, long-term impacts on capacity, and benefits to be derived from RSM principles and non-traditional management.